B TECH PROJECT
2012

A STUDY ON THE QUALITY OF THE WATER RESOURCES OF CUTTACK CITY

DEPARTMENT OF CIVIL ENGINEERING, NIT Rourkela

A Thesis Submitted by
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108CE012

A STUDY ON THE QUALITY OF THE WATER-RESOURCES OF CUTTACK CITY

A THESIS SUBMITTED FOR THE PARTIAL FULFILMENT OF REQUIREMENTS FOR DEGREE OF BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

BY

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UNDER THE GUIDANCE OF

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ROURKELA-769008.

CERTIFICATE OF APPROVAL

It is certified that the thesis entitled **A STUDY ON THE QUALITY OF THE WATER-RESOURCES OF CUTTACK CITY** submitted by **Mr. Mayuresh Panda (108CE012)** has been strictly carried out under my supervision for partial fulfillment of requirements for the Degree of **Bachelors of Technology** in **Civil Engineering** from National Institute of Technology, Rourkela, and this work has not been plagiarised from elsewhere to the best of my knowledge.

.....

Prof S. Jena
Assistant Professor
Department of Civil Engineering
National Institute of Technology, Rourkela

ACKNOWLEDGEMENT

I am really privileged to have done my project work under the supervision of Sri S. Jena whose invaluable advise , apt mentoring and guidance as well as support throughout my project kept me on the right track and to act according to my potential.

I would also like to offer my sincere gratitude to Prof. Ramakar Jha for his excellent tips for my project from time to time.

Last but not the least, I would also like to express my obligations to the Environmental Engineering laboratory assistant, without whose help I could never have finished the project in this stipulated time period .

MAYURESH PANDA

108CE012

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ABSTRACT

. Cuttack is a delta surrounded by the Mahanadi and the Kathajodi rivers on the eastern coast of Odisha. It has been the heart of all business activities and many industries of the state on account of easy access and its location from the old days. As the days passed by, the city constantly experienced a penetrating population from the outskirts as well as from various parts of the state. Due to the presence of rivers on both the sides, the city is restricted to expand its land area and it has been the sole reason for such a thickly populated scenario now-a-days. According to the 2011 census, the population density of Cuttack is about 666/km^2 and the population of the city is 26,18,764.

The chemical and poisonous effluents from the industries are also heavily affecting the atmosphere and water sources which are the surface water and ground water. The surface water mainly constitutes of the Kathajodi and Mahanadi rivers. There also lie a considerable amount of non-point sources on both the sides of these two rivers which can never be neglected as they have a typical impact on the water quality. These sources discharge into the rivers in plenty due to the lack of stringent rules and regulations.

As the city collects its water from the two rivers and a considerable amount of population depends upon the river directly for their daily use, a study has become necessary in the present days to determine suitability of these river water for health and industrial purposes.

Keywords : Cuttack, Mahanadi, Kathajodi, Pollution

CHAPTER 1

INTRODUCTION

1.1 Need of the Study :

Our planet Earth is a live planet because of some special ingredients out of which water plays a great role. Water has been considered as the most important and vital resource for the upbringing of the biological sphere as well as the human civilisation. The other agents which are responsible for the biosphere on globe are Air, Heat, Soil and Sky. All these agents are linked in between themselves to a much greater extent and any irregularities in one of them affects others as well. Along with the progress of our civilisation, this resource has begun being polluted and its quality started depleting due to various reasons like the onset of industry, domestic wastes, runoff from urban areas, urban and rural garbage.

With the onset and progress of human civilisation, it has constantly been observed that the coastal areas as well as the river banks have been the most populated spots on account of the availability of ample water resources for the maintenance of daily life along with farming and other climatic advantages. The cities and towns always have shown a rising trend of population because of the easy earning sources due to the various industries which are set up to meet the increasing demand of the growing civilisation. Because of this, day by day the urban areas are being more densely populated and as a result, the surrounding areas of the cities are suffering from various kinds of pollutions like the air pollution, water pollution, soil pollution and many more due to the sewage, garbage, dumps and barnyard manures etc.

Similarly, Cuttack is a delta surrounded by the Mahanadi and the Kathajodi rivers on the eastern coast of Odisha. It has been the heart of all business activities and many industries of the state on account of easy access and its location from the old days. The chemical and poisonous effluents from the industries are also heavily affecting the atmosphere and water sources which are the surface water and ground water. The surface water mainly constitutes of the Kathajodi and Mahanadi rivers.

There also lie a considerable amount of non-point sources on both the sides of these two rivers which can never be neglected as they have a typical impact on the

water quality. These sources discharge into the rivers in plenty due to the lack of stringent rules and regulations.

1.2 Objective of the Study :

The chief and primary sources of water supply to the city are the two rivers. Their water is used as the main domestic supply through municipality pipes and its use spreads across various fields of life in the city. A considerable amount of the population uses the river water directly for fulfilling their daily demands. Considering the requirement of the availability of pure water which meets the public standards for the daily use purpose, the water of these rivers as well as the ground water must be pure and clean which doesn't have the potential to cause any threat for the health of people.

A few studies have been carried out to determine the water quality of these rivers for the purpose of finding out the suitability of their domestic and industrial use. So, the sole purpose of this study is to assess the present scenario of water quality of the two rivers as well as the ground water of the Cuttack city. This has been shown in the following map.

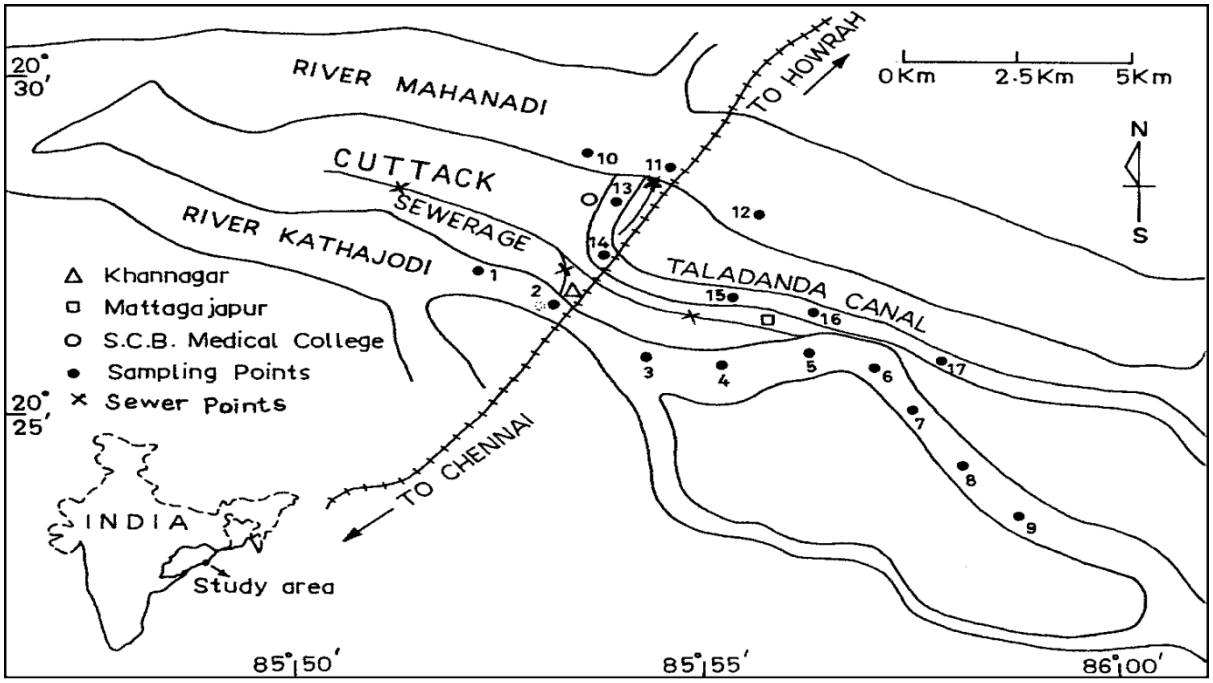


Fig 1.1

CHAPTER 2

LITERATURE REVIEW

As mentioned earlier, a few studies have been carried out regarding the surface and ground water quality of Cuttack city. A study carried out by the researchers shows that the ground water of Cuttack city collected near drains exceeded the value recommended by IS:10500 for NO_3^- and Na^+ (Das, Sahoo and Sinha ; 2008).

Another study by the researchers of Banki Autonomous College reveals that the surface water quality is a bit acidic mainly at the both ends of the city due to the presence of industry. Higher values of bicarbonates also indicate the hardness of the surface water (Das et al ; 2009).

In another study, it has been found out that there is severe concentration of dissolved metal in the water due to heavy pollution on account of industrial pollution. The salinity played a major role in the water chemistry. The major reasons behind the pollution were the agricultural inputs and industrial effluents (Chauhan and Ramanathan ; 2008).

A group of researchers from Bhubaneswar state that the deoxygenation rate of the lotic water of the city was much higher than the reoxygenation rate (Das and Acharya ; 2003).

The 'Odisha State Pollution Control Board' also conducts annual tests before, on and after Kartik Purnima to determine the parameters like pH, Total dissolved solids, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) etc. which can be used as a handy source of information.

CHAPTER 3

SAMPLING TECHNIQUES

3.1 Study Area :

For having a thorough knowledge about the present scenario, the project work was divided into three categories which were carried out in the due course of time. The parts which constitute the project are :.

1. Study of the Kathajodi River
2. Study of the Mahanadi River
3. Study of Ground Water.

The sampling site for the Kathajodi river was Khannagar and those for the Mahanadi were Gadgadia ghat, Zobra and Kanheipur. The ground water samples were collected from Madhupatna, Buxibazar and Bidanasi. The sampling stations have been highlighted in the following map. The Mahanadi flows on the northern side and the Kathajodi is on the southern side. The rectangles depict the ground water sampling stations.


Peer Bazar
Jagatpur
Kendrapara PH
Mandapara
Jobra Anicut
Municipal Colony
LIC Colony
Cuttack Railway
Professors Colony
Manglabagh
Ramihat Colony
Cuttack
Old LIC Colony
Shankarpur Colony
Katha Jori Station
Rajabagicha
Darga Bazaar
Buxi Bazaar
Biju Patnaik Colony
Mehendipur
Chandini Chowk
Nimchouri
Mahammadia Bazaar
Tulasipur Colony
Deulasahi Colony
Masik Patna Colony
Tulsipur
Police Colony
Kaphala Colony
Bidanasi
CDA Sector VI
CDA Sector 11
Biju Pattanaik Park
Shelter Rd
Cuttack-Naraj Road
Naraj Barrage
Naraj
Mahanadi Vihar
Survey and Agriculture Settlement colony
Shastri Nagar
Naya Bazaar
Police Line
Bidyadharpur
Gautam Nagar
Nuasahi
State Highway 12
MLD Sewage Treatment Plant
Madhu Patna Colony
Kalyani Nagar
Industrial Estate Khapuria
Government Press Employee Quarters
Matagajpur
Dihasahi
Biribati
Jharakata
Berhampur
Jhinkiria
Khanna
Netaji Nagar
Gopalpur Balikuda
Belagachhia
Baranga Rd
Barkhi Rd
Barkhi Rd
Dadhapatna
Map data ©2012 Google
2 km
1 mi

Fig 3.1

3.2 Sampling Procedure :

The samples were collected on a monthly basis for both the rivers. They were normally collected in the afternoons in two plastic non-reacting bottles of 2litres capacity each. Immediately after sampling, preservatives were added to them and the bottles were recapped and sealed by the application of hot molten wax. These sealed bottles were put in a thermocol box and the box was put inside a deep fridge till it was carried to NIT Rourkela for carrying out the laboratory analysis. Sodium thiosulphate preservatives were used for sampling in tablet forms.

General Rules of Sampling :

Take some extra care to avoid the contamination of the water sample and the container.

Don'ts :

Contaminate the bottle by the touching the inside of bottle.

Contaminate the bottle lid through touching the inside.

Put the bottle lid on the ground while doing sampling.

Rinse the bottle before sampling .

Transport the aquatic facility water samples with other water samples .

Sampling Collection Procedure :

1. If wearing the long sleeve shirt, roll sleeves of the shirt up past elbow

2. Take a labelled sterile the 250ml sample bottle. Make sure that you keep the lid on the bottle .

3. Hold sterile bottle in hand near it's base, and carefully remove and hold cap with the other hand. Don't touch the inside of the cap when sampling.

4. Tip enough water from bottle to leave air space of about 1-2 cm from rim of the bottle.

5. Carefully replace the cap immediately .

CHAPTER 4

EXPERIMENTS

4.1 Experiment Parameters :

After the samples were preserved and brought to the laboratory, various experimental analysis were carried out on them in order to determine the water quality. The parameters for which tests were conducted include the following viz.

- Test for alkalinity i.e. pH Test
- Test for Turbidity
- Test for Dissolved Oxygen (DO)
- Test for Biochemical Oxygen Demand (BOD)
- Test for Total Solids
- Test for Hardness
- Test for Iron content
- Test for Chloride content

The experiments were carried out at the Environmental Engineering Laboratory of Civil Engineering Department . The DO and BOD are the parameters of great importance and are interrelated. BOD shows us the presence of micro organisms in a water body. Turbidity, Total Solids and Hardness directly give us a measure to decide whether the water meets the desirable and required conditions or not.

4.2 Analysis :

The basic purpose of conducting the analysis work is to compare the results for various parameters of the given water sample with the IS:10500 drinking water standard and as well as the required steps can also be taken for disinfection and others purposes.

4.2.1 Analysis method for pH :

The pH value of the water sample is nothing but the logarithm of the reciprocal of hydrogen ions activity present in moles per litre. For neutral sample, it is generally found to be around 7. If it is less than 7, the sample is considered to be acidic and for the opposite case, it is taken as basic. For general water, ph ranges between 6 to 8.

Procedure :

- The pH value of a given water sample can be measured directly in modern days by using a pH meter.
- A beaker or glass in association with a calomel electrode is dipped into the water and it detects the concentration of Hydrogen ion.
- The meter is pre calibrated by using standard solution of known pH values and can be used directly to read the value.

4.2.2 Analysis method for Turbidity :

Turbidity is caused in natural waters by finely divided suspended particles of clay, silt, sand or some organic materials. The standard unit for turbidity is that turbidity which is produced by mixing 1mg of finely divided silica (SiO_2) in distilled water.

The apparatus used for measuring Turbidity of water sample is 'Nephelometer' which uses the principle of scattering of light. In this instrument, the sample scatters the light that impinges on it. The scattered light is measured by photometers which are kept at right angles to the original direction of the light. The unit used for the measurement of Turbidity is known as the Nephelometric Turbidity Unit (NTU).

Procedure :

- A small beaker is used for testing the sample inside the Nephelometer.
- It is first properly cleaned and filled with distilled water.
- The beaker containing distilled water is kept inside the instrument and the value is adjusted to zero.
- The sample of water is then replaced in the beaker and test is carried out.
- The value of Turbidity is displayed on the monitor and it is taken down.

4.2.3 Analysis Method for Dissolved Oxygen :

Dissolved Oxygen in a water sample is detrmined by following Winkler's method. The saturation DO value is the maximum dissolved oxygen which a given water can contain at a given temperature and pressure. In this principle, the water sample to be tested is mixed with manganese sulphate ($MnSO_4$) and an alkali iodide reagent. The Mn^{2+} ions released from $MnSO_4$ react with OH^- ions of water to form white precipitate if no dissolved oxygen is present otherwise they give rise to a red precipitate.

$$Mn^{2+} + 2OH^- \rightarrow Mn(OH)_2 \text{ (white precipitate)}$$

$$Mn^{2+} + 2OH^- + ½\ O_2 \rightarrow MnO_2 \text{ (red precipitate)} + H_2O$$

MnO_2 then oxidises I^- ion to Iodine (I_2).The amount of I_2 is estimated from titration with the N/40 Sodium Thiosulphate. The expected DO value for suitability in domestic use is 4-8mg/ltr.

Procedure :

- The 300ml BOD bottle is rinsed and filled with 100ml of the sample.
- 2ml of manganrse sulphate and 2ml of azide alkali potassium iodide is added to the water.
- If red precipitate is formed then 2ml of concentrated sulphuric acid is added for the formation of iodide.

- Then it is titrated against the N/40 sodium thiosulphate solution using starch indicator until the blue colour just disappears.

4.2.4 Analysis Method for Biochemical Oxygen Demand (BOD) :

BOD shows us the the extent of micro-organisms present and their behaviour in a water-sample. It gives the value of the amount of oxygen required for complete biological decomposition of waste and organic matter present in water thereby reducing the carbonaceous material from the water.

BOD is measured using the Oxytop measuring instrument. The oxytop measuring system is based upon pressure measurement which notes the pressure by perizoresistive electronic sensors. It can note the features like automatic temperature detection, data logging and measuring range value.

Procedure :

- The BOD bottle is properly rinsed first.
- The oxygen saturation is then exactly measured.
- The magnetic stirring rod is put in the bottle.
- 2 sodium hydroxide tablets are put into the rubber quiver with a tweezer.
- Oxytop is screwed directly on the top of the bottle.
- The bottle is kept for 5 days at 20^0C.
- The oxytop automatically starts measuring the oxygen consumption/
- This recorded value is then converted to BOD^5_{20} value with the help of standard tables.

4.2.5 Analysis Methods for Total Solids :

The total amount of solids consists of the suspended solids with the dissolved solids. The total solids in a sample can be determined by evaporating the water sample and weighing the left residue. The amount of suspended solids is obtained by filtering the water sample and weighing the residue left on the filter paper. The difference between the total solids and the suspended solids gives the amount of dissolved solids.

Procedure :

- The crucible is cleaned at first and then put on an oven.
- Then it is placed on the desiccator until it cools and then the weight is taken.
- 100ml of sample are taken in the crucible dish and it is placed in an oven for 24 hours.
- Then it is taken out of the oven and the weights are noted down.

4.2.6 Analysis method for Hardness of water :

Hardness of water is that characteristic which prevents the formation of sufficient foam. The hardness is usually caused by the presence of calcium and magnesium present in water which for scum by reaction with floc. Hard water are undesirable because they lead to greater soap consumption. Carbonate hardness is caused by the divalent metallic ions principally of Ca^{2+} and Mg^{2+} while sulphates, chlorides and nitrates cause non-carbonate hardness.

Procedure :

- 50 ml of the sample was pipetted into the burette.
- The standard soap solution was added in small proportion at first shaking vigorously after each addition.

- As the end point was approached, the quantity added should be reduced to 0.1ml per each addition.
- After a permanent lather was produced, the amount of soap solution used was recorded.
- The addition of soap continued if lather disappeared again.
- It was continued until the amount of soap solution was able enough to create a lather that could last up to 5 minutes.

4.2.7 Analysis Method for Iron content :

Iron in water exists as ferrite and ferric ions. Iron is very important for a healthy body and the deficiency of this nutrient results in anaemia. Higher concentratrion of iron in water can cause staining of fondry and porcelain when used in industry. The iron content of surface water seldom reaches 1mg/ltr.

Procedure :

- Four volumetric flasks are chosen and cleaned thoroughly.
- 100ml of distilled water is taken in each of them.
- Fe solution was mixed to make 1,2,3,4 ppm solution in the samples.
- These samples were tested in the absorption spectrometer to get the plot of absorbance ~ concentration.
- With the help of the graph obtained from the above step, the river water sample was tested and directly it gave the concentration of iron in the sample.

4.2.8 Analysis Method for Chloride Content :

Chlorides are widely found in all water samples and reasonable amount of chlorides are not harmful though they cause a threat if the concentration surpasses 250mg/ltr. The principle of chloride detection works on the following outlines : This method uses Silver Nitrate ($AgNO_{3)}$ because silver ions combine with chloride ion to produce a white precipitate of Silver Chloride (AgCl). The end point is determined by using potassium chromate indicator. Chromate ions combine with silver ions to form a reddish brown precipitate of silver chromate. This gives the evidence that all chloride has been precipitated.

Procedure :

- 50ml of sample is pipetted in two porcelain dishes.
- 1 ml of potassium chromate indicator was added.
- Standard silver nitrate solution was added to the sample with constant stirring until a permanent reddish colour appears.
- The amount of $AgNO_3$ used was noted and from this the chloride is calculated.

CHAPTER 5

RESULTS & DISCUSSIONS

5.1 Project Work :

The chief part of the project work consists of monthly sampling of the Kathajodi and the Mahanadi river . The samples were preserved and carried to the Environmental engineering laboratory of NIT Rourkela and subsequent tests were carried out on the samples in a period of hardly two days. For these times, the samples are kept in a deep fridge with proper measures.

The project work and its results can be broadly classified into three parts namely :

- Project Kathajodi
- Project Mahanadi
- Ground Water Survey

5.2 Results :

The results obtained for different parameters from the timely monthly samplings and subsequent tests are expressed through the following tables and graphs. The data for the last 10 years were also collected from the office of 'Odisha State Pollution Control Board' and the data of last 4 years were analysed through the help of various charts.

5.2.1 Project Kathajodi :

It consists of two parts namely (i) Sampling Results and (ii) OSPCB Data.

5.2.1.1 Sampling Results :

Table 5.1

Parameter	Value
1. pH	7.4
2. Turbidity (mg/ltr)	21.0
3. DO (mg/ltr)	7.5
4. BOD (mg/ltr)	1.08

Table 5.2

Parameter	Value
1. pH	7.3
2. Turbidity (mg/ltr)	13
3. DO (mg/ltr)	7.1
4. BOD (mg/ltr)	1.05
5. Total Solids (mg/ltr)	43.00
6. Iron Content (mg/ltr)	57
7. Chloride (mg/ltr)	172
8. Hardness (mg/ltr)	162

Table 5.3

Parameter	Value
1. pH	7.3
2. Turbidity (mg/ltr)	13
3. DO (mg/ltr)	7.1
4. BOD (mg/ltr)	1.05
5. Total Solids (mg/ltr)	43.00
6. Iron Content (mg/ltr)	57
7. Chloride (mg/ltr)	172
8. Hardness (mg/ltr)	162

Table 5.4

Parameter	Value
1. pH	7.3
2. Turbidity (NTU)	18
3. DO (mg/ltr)	7.2
4. BOD (mg/ltr)	1.47
5. Total Solids (mg/ltr)	39.10
6. Iron Content (mg/ltr)	65
7. Chloride (mg/ltr)	178
8. Hardness (mg/ltr)	142

5.2.1.2 OSPCB Data Analysis :

OSPCB conducts 3 tests annualy for the Kathajodi and the Mahanadi rivers. The three tests are carried out before, on and after Kartik Purnima. The data expressed here through graphs have been collected from 4 stations viz. Mundali (M), Purighat (P), Khannagar (K) and Gopalpur (G) for the years 2007, 2008, 2009 and 2010. The parameters are pH, Total Solids (TSS), Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD). The results have been expressed in the following charts.

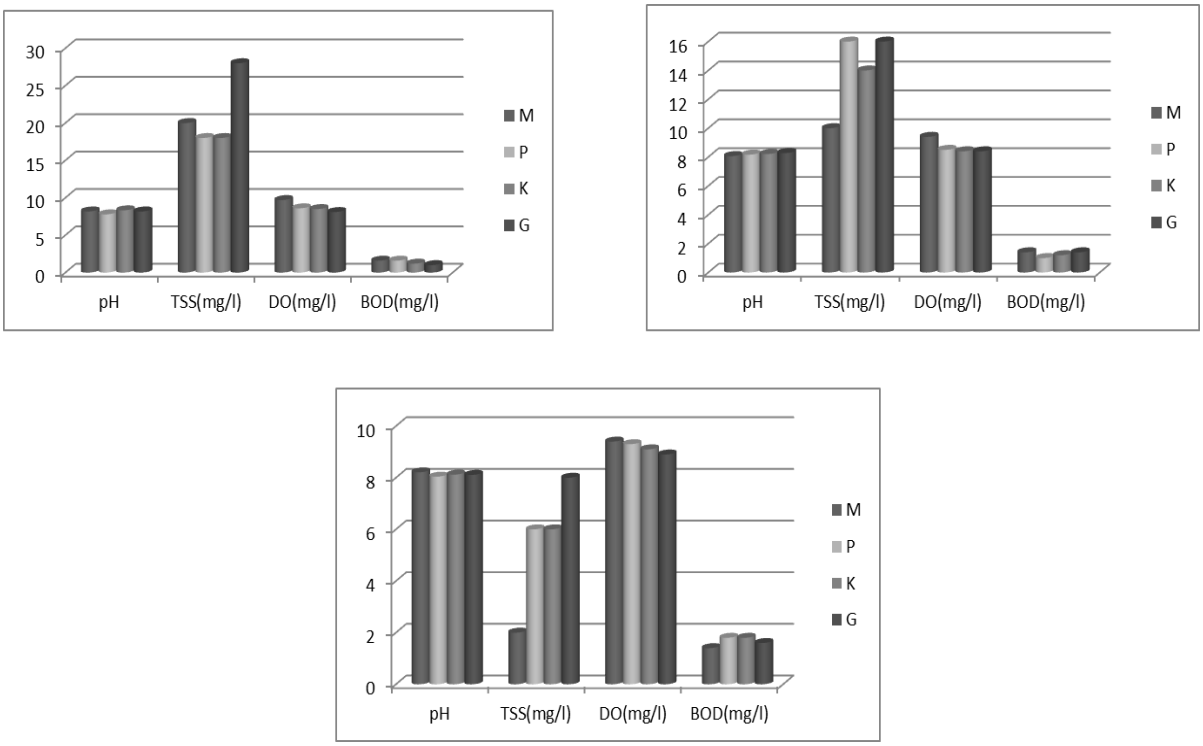
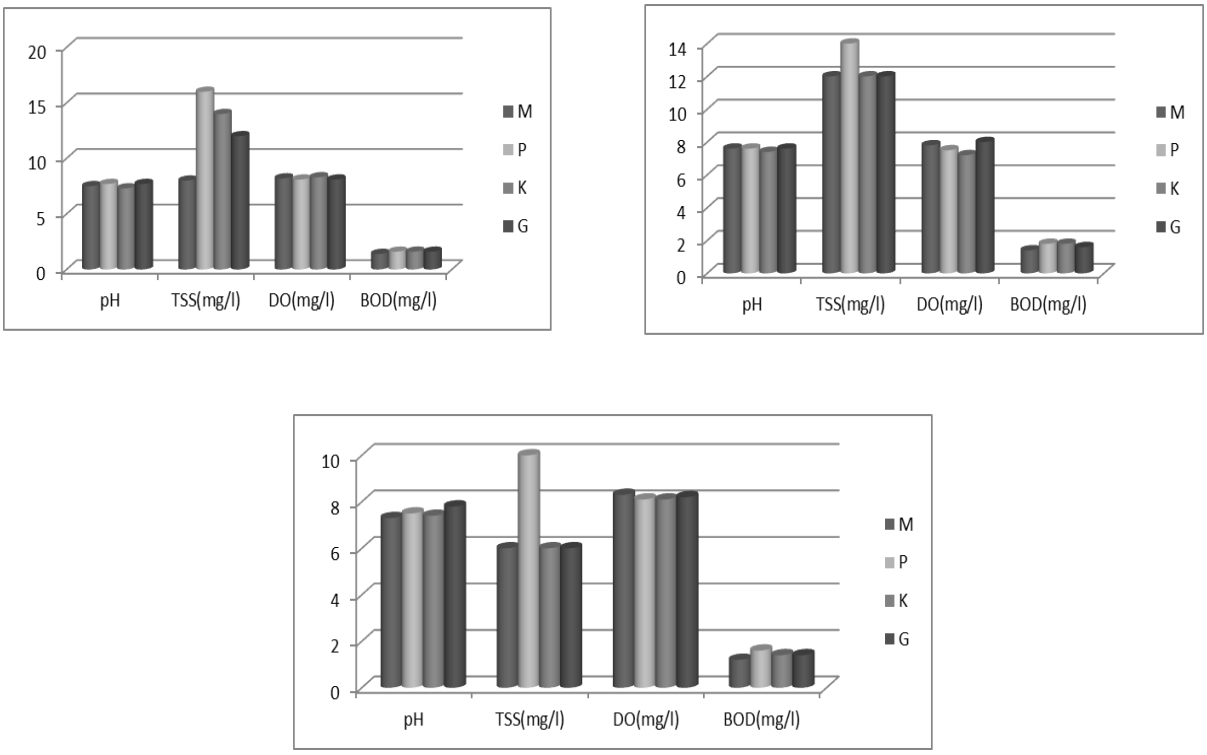


Fig 5.1


20
15
10
5
0
pH
TSS(mg/l)
DO(mg/l)
BOD(mg/l)
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14
12
10
8
6
4
2
0
pH
TSS(mg/l)
DO(mg/l)
BOD(mg/l)
M
P
K
G
10
8
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pH
TSS(mg/l)
DO(mg/l)
BOD(mg/l)
M
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Fig 5.2

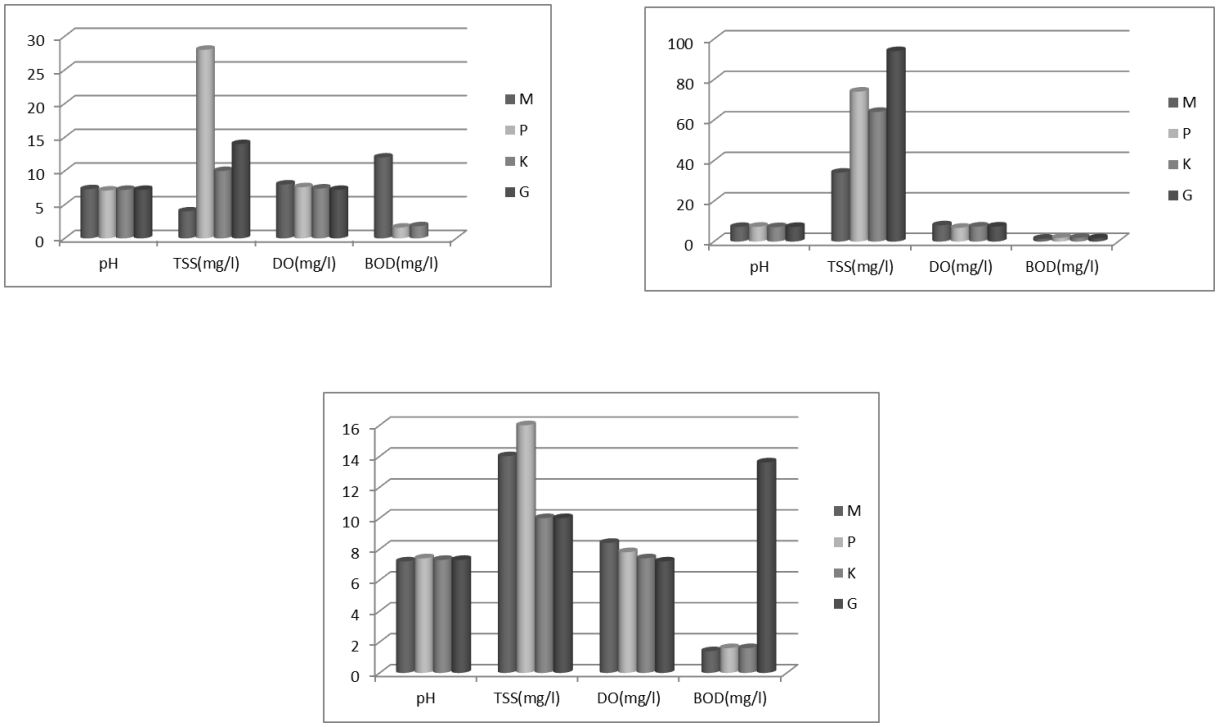
30
25
20
15
10
5
0
pH
TSS(mg/l)
DO(mg/l)
BOD(mg/l)
M
P
K
G
100
80
60
40
20
0
pH
TSS(mg/l)
DO(mg/l)
BOD(mg/l)
M
P
K
G
16
14
12
10
8
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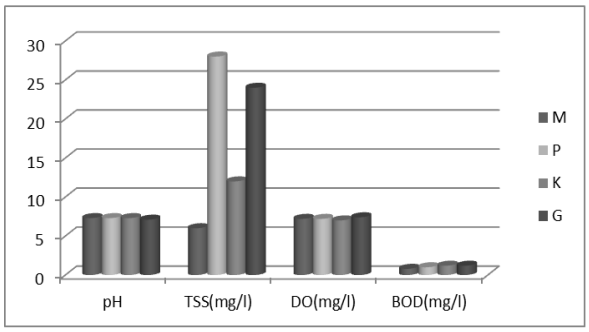
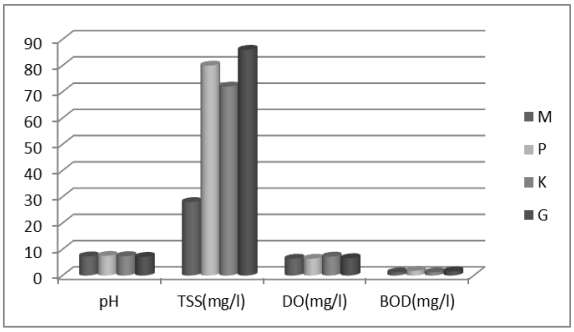
Fig 5.3





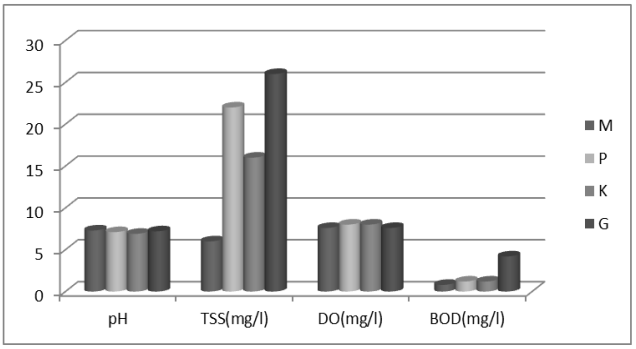
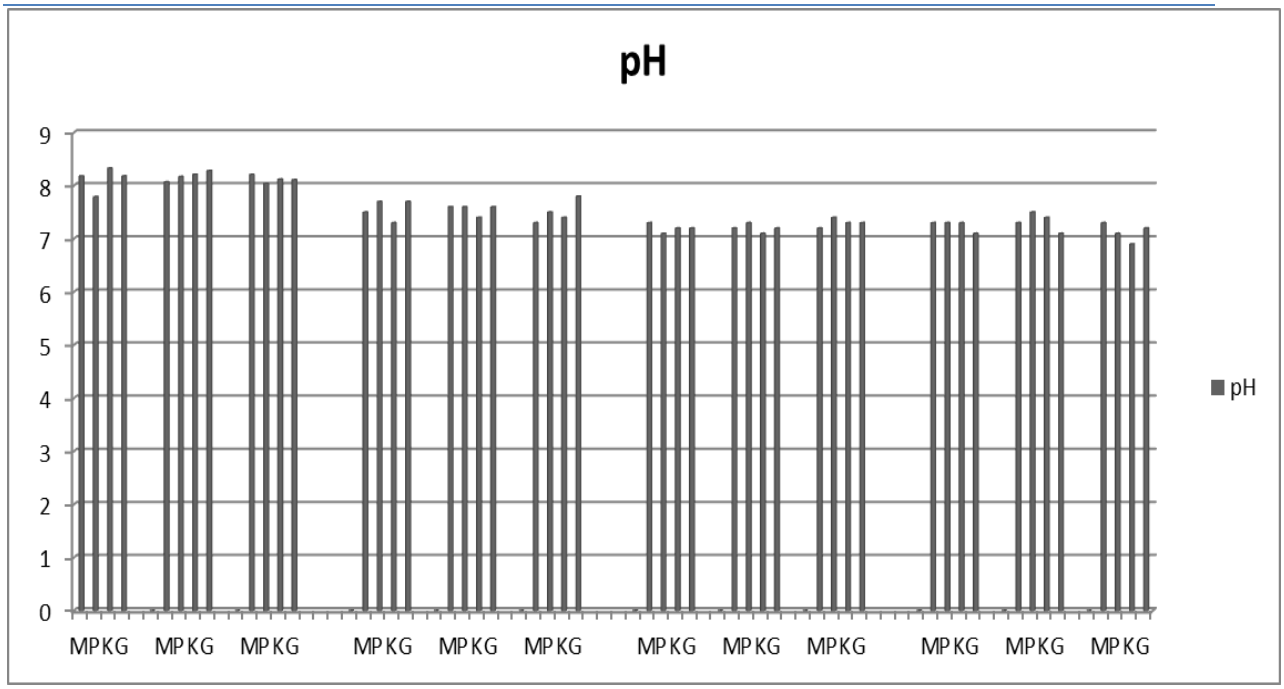


Fig 5.4

The BOD and Turbidity are showing much higher values in some cases especially at Gopalpur. The causes might be that Gopalpur is a huge village and people are directly dependent on the river for their maintenance of daily life. Another cause might be that as it lies at one end of the city so obviously the concentration of the pollutants is higher at this place.


pH
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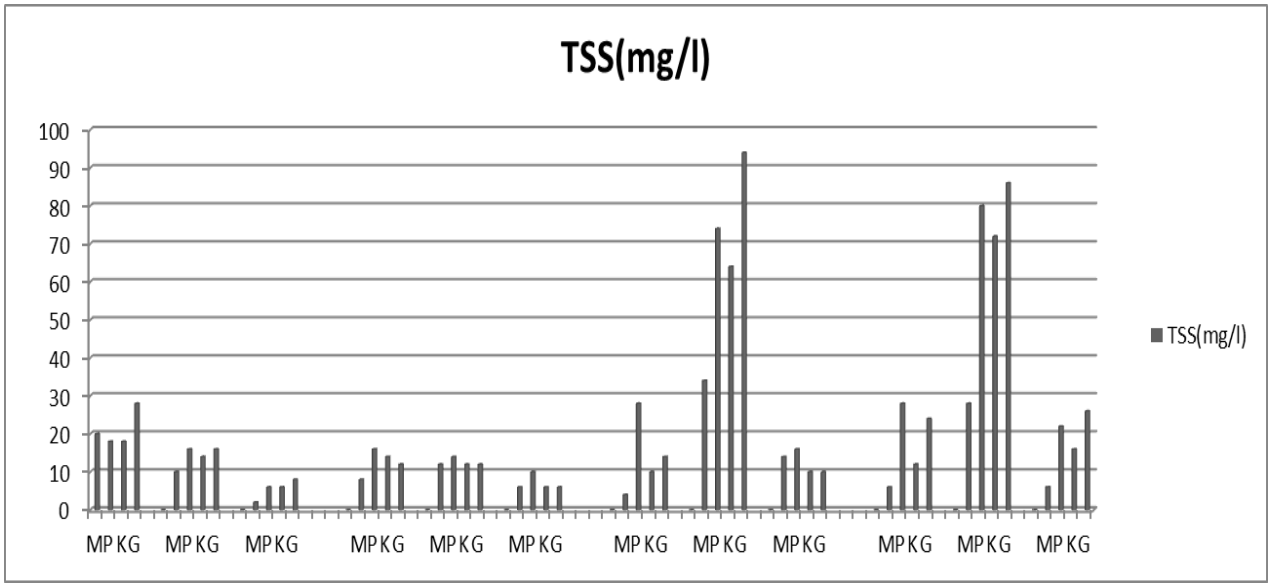
pH

Fig 5.5


TSS(mg/l)
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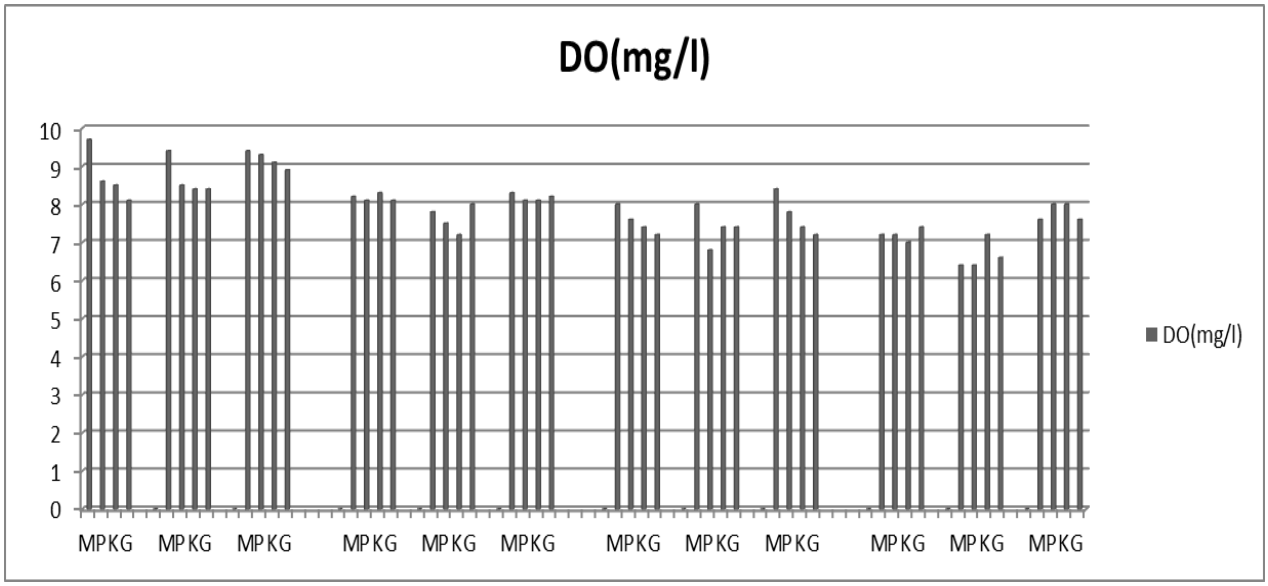
TSS(mg/l)

Fig 5.6


DO(mg/l)
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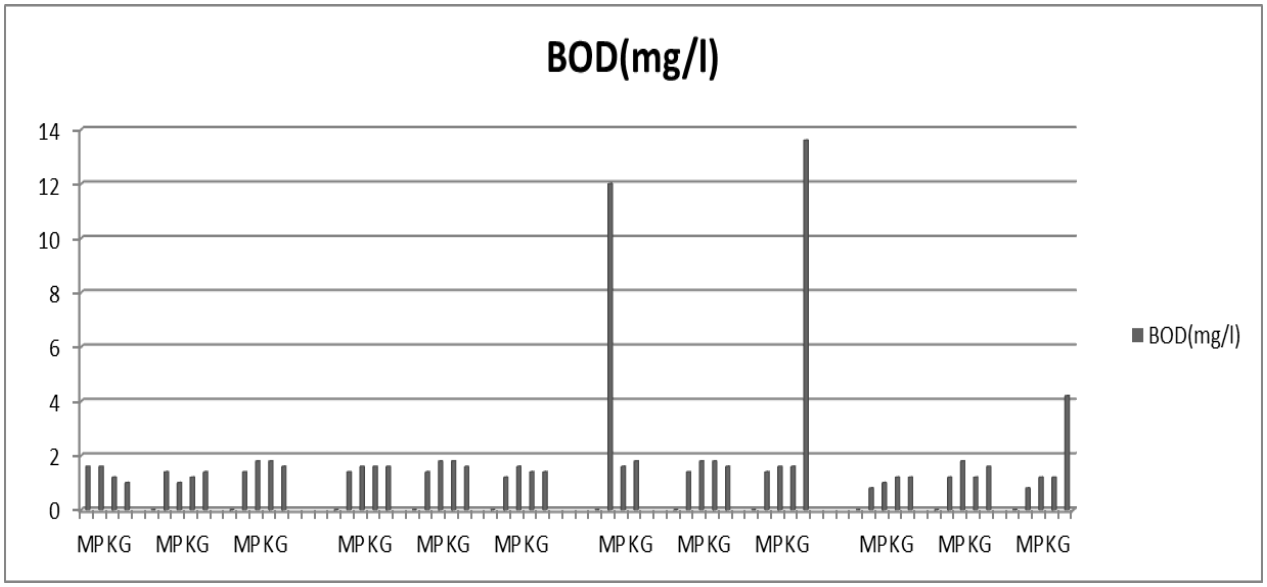
DO(mg/l)

Fig 5.7


BOD(mg/l)
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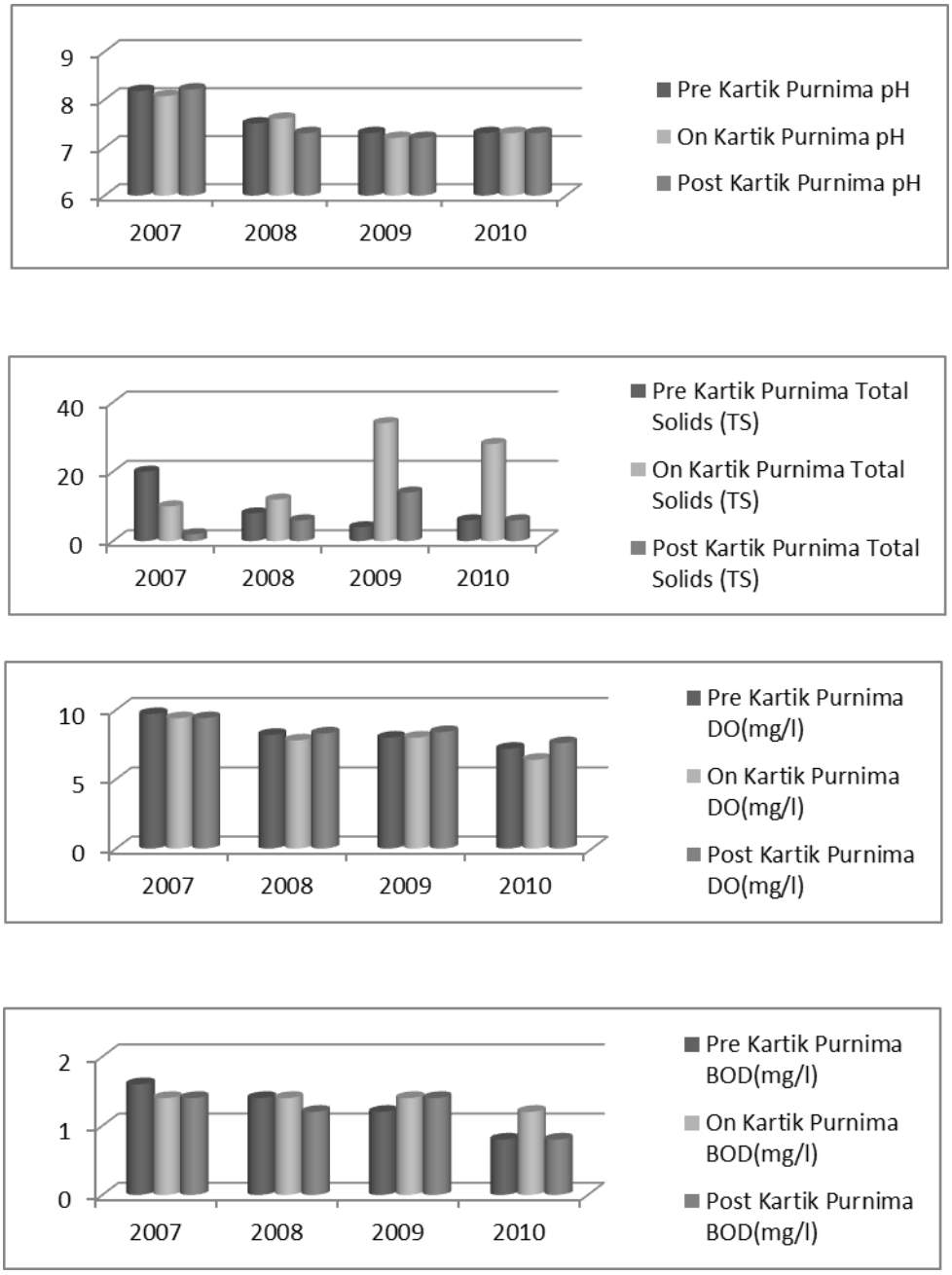
BOD(mg/l)

Fig 5.8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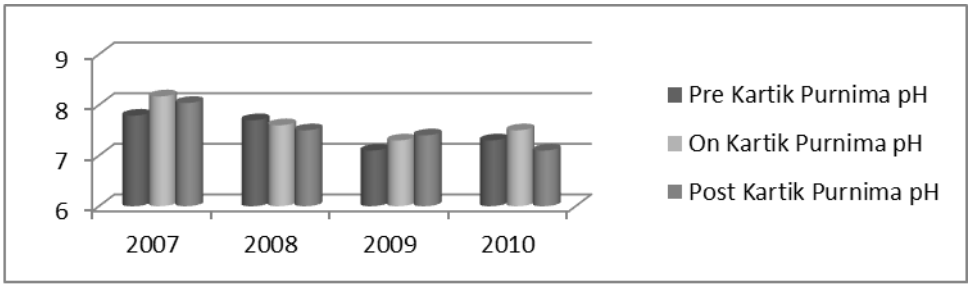
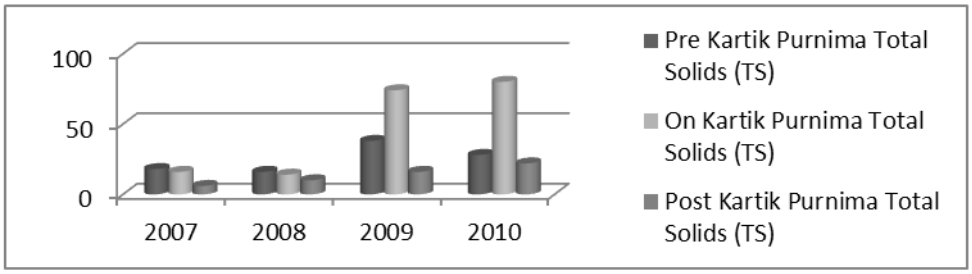
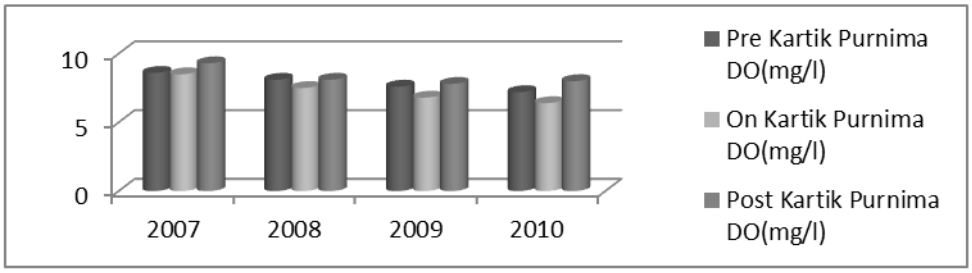
7
6
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH
40
20
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)
10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)
2
1
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)
Post Kartik Purnima BOD(mg/l)

Fig 5.9


9
8
7
6
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH


100
50
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)

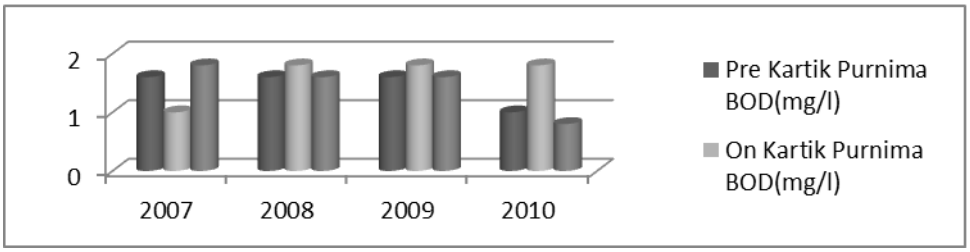
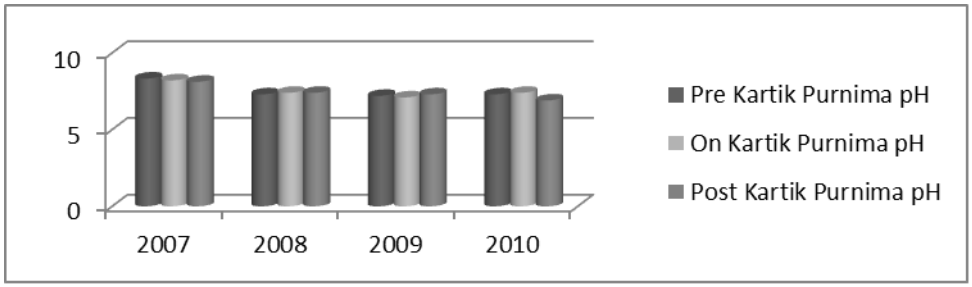
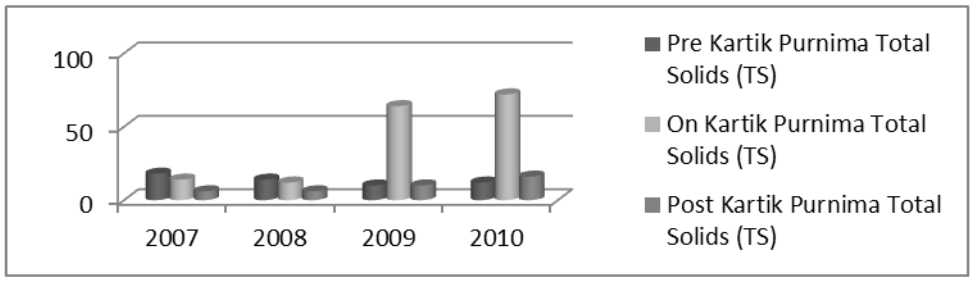
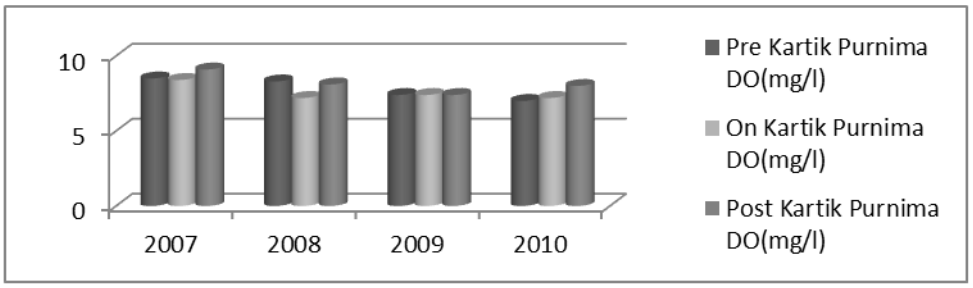

2
1
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)

Fig 5.10


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH


100
50
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)

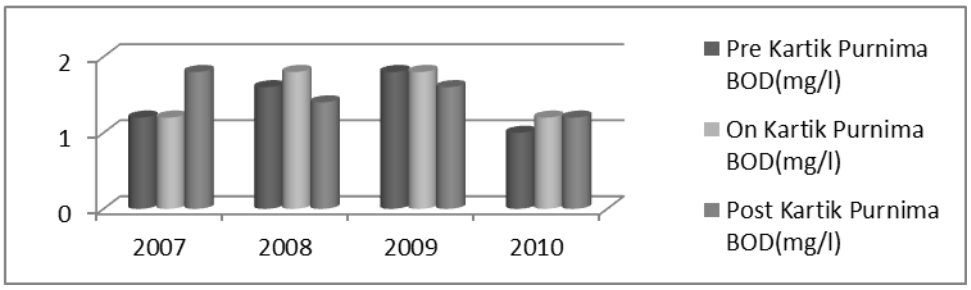
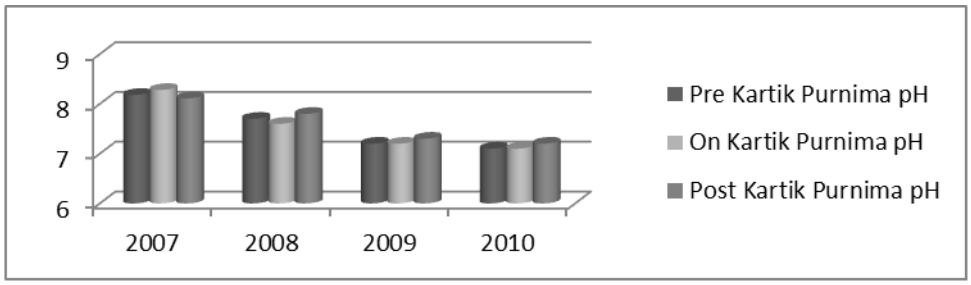
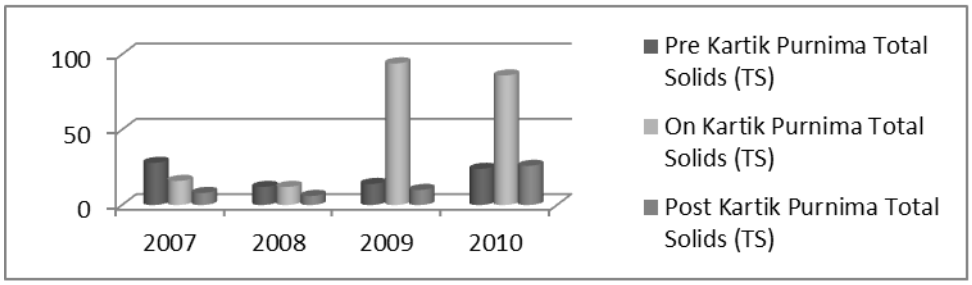
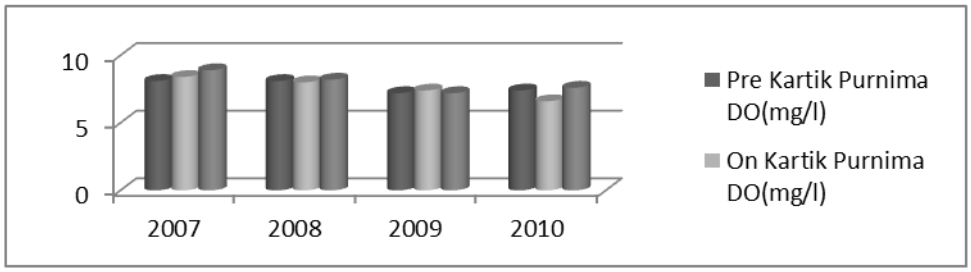

2
1
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)
Post Kartik Purnima BOD(mg/l)

Fig 5.11


9
8
7
6
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH


100
50
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)

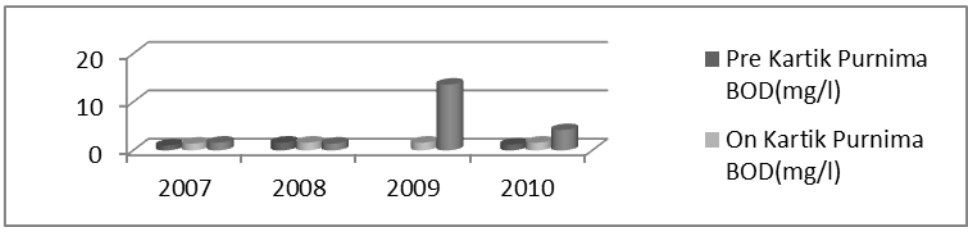

20
10
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)

Fig 5.12

5.2.2 Project Mahanadi :

Like Kathajodi, Project Mahanadi also consists of two parts namely (i)Sampling Results (ii)OSPCB data analysis.

5.2.2.1 Sampling Results :

After the completion of sampling and tests for the river Kathajodi , the project work for the 8th semester was the sampling and finally fitting a model for evaluating the the effect of population of Cuttack city on the water quality of the Mahanadi and the Kathajodi with the passage of time.

This time, unlike Kathajodi , 3 sampling points were chosen throughout the whole stretch of the Mahanadi in Cuttack which are nearly equidistant viz. Gadgadia ghat, Zobra and Kanheipur . The distance between Gadgadia ghat and Zobra is 6kms and that between Zobra and Kanheipur is nearly 7.5kms .

Table 5.5

Sampling Point	pH	Turbidty NTU	DO Mg/ltr	BOD Mg/ltr	Total Solids Mg/ltr	Iron Content Mg/ltr	Hardnes Mg/ltr	Chloride Mg/ltr
Gadgadia ghat	6.7	58	8.2	1.3	39.90	84	146	131
Zobra	6.9	22	8.0	1.8	40.06	68	153	146
Kanheipur	6.9	18	8.6	2.0	34.74	77	169	152

Table 5.6

Sampling Point	pH	Turbidty NTU	DO Mg/ltr	BOD Mg/ltr	Total Solids Mg/ltr	Iron Content Mg/ltr	Hardnes Mg/ltr	Chloride Mg/ltr
Gadgadia ghat	6.85	32	8.1	1.3	38.75	76	168	122
Zobra	6.65	18	8.2	1.5	41.22	39	152	143
Kanheipur	6.9	21	7.8	1.75	34.82	61	131	127

Table 5.7

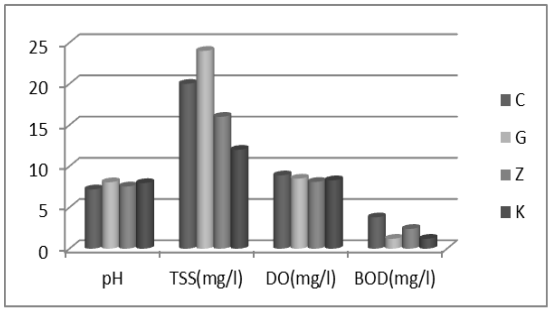
Sampling Point	pH	Turbidty NTU	DO Mg/ltr	BOD Mg/ltr	Total Solids Mg/ltr	Hardnes Mg/ltr	Iron Content Mg/ltr	Chloride Mg/ltr
Gadgadia ghat	7.3	28	7.4	1.6	35.25	142	57	97
Zobra	6.9	26	8.2	1.3	34.17	196	34	121
Kanheipur	6.9	21	7.8	1.75	34.82	181	81	103

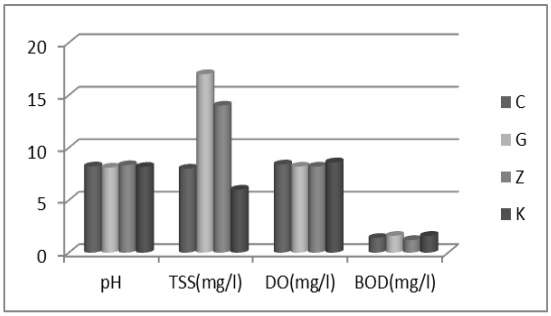
Table 5.8

Sampling Point	pH	Turbidty NTU	DO Mg/ltr	BOD Mg/ltr	Total Solids Mg/ltr	Hardnes Mg/ltr	Iron Content Mg/ltr	Chloride Mg/ltr
Gadgadia ghat	7.5	26	7.2	1.2	28	124	57	87
Zobra	7.3	30	7.8	1.4	29.8	174	34	91
Kanheipur	8.1	21	8.1	1.8	41.1	169	81	94

5.2.2.2 OSPCB Data Analysis :

OSPCB conducts 3 tests annualy for the Kathajodi and the Mahanadi rivers. The three tests are carried out before, on and after Kartik Purnima. The data expressed here through graphs have been collected from 4 stations viz. Chahata Ghat (C), Gadgadia ghat (G), Zobra (Z) and Kanheipur (K) for the years 2007, 2008, 2009 and 2010. The parameters are pH, Total Solids (TSS), Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD). The results have been expressed in the following charts.





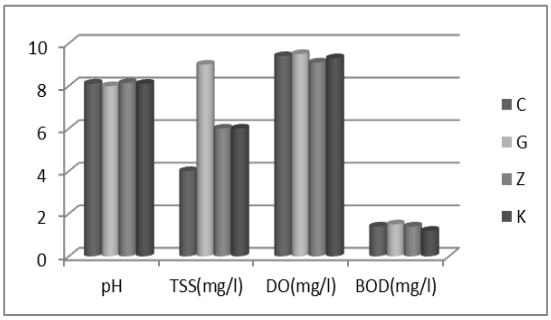
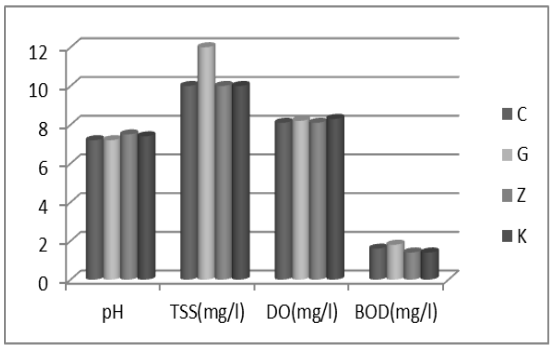
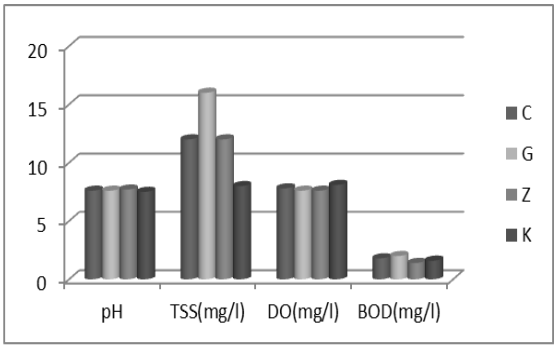


Fig 5.13





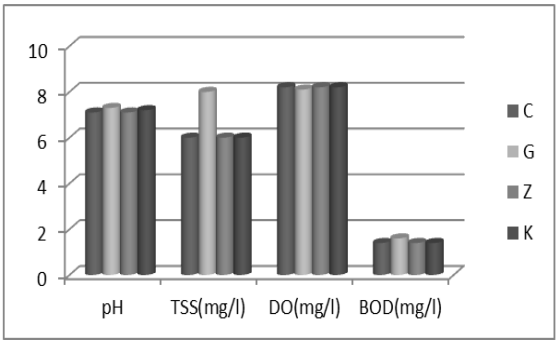
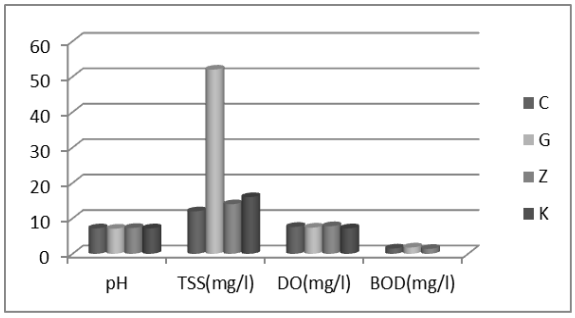
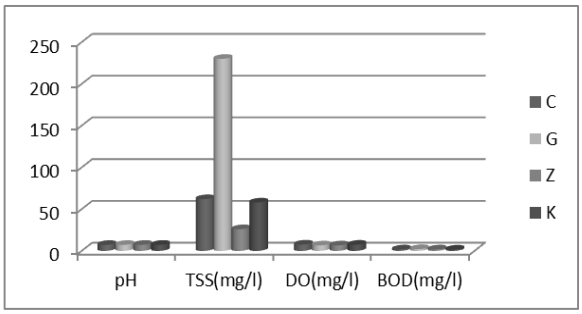


Fig 5.14





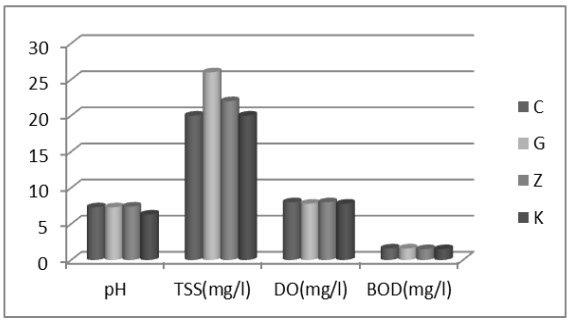
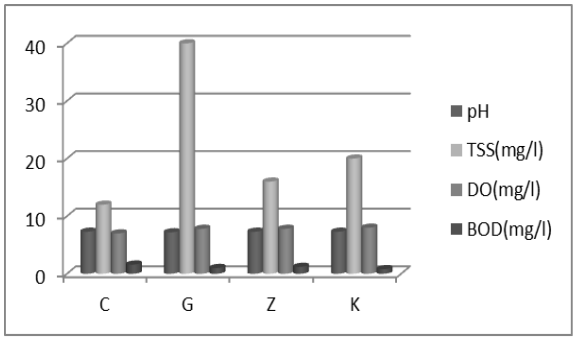
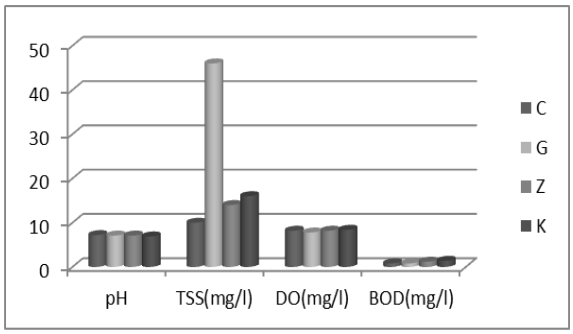


Fig 5.15





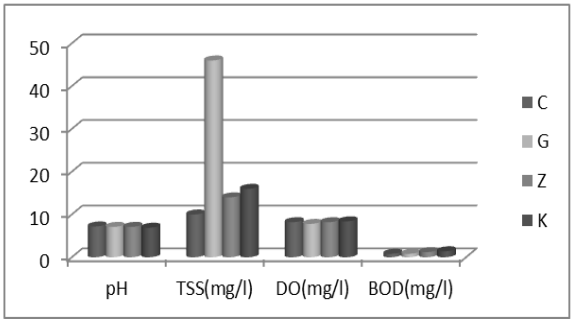
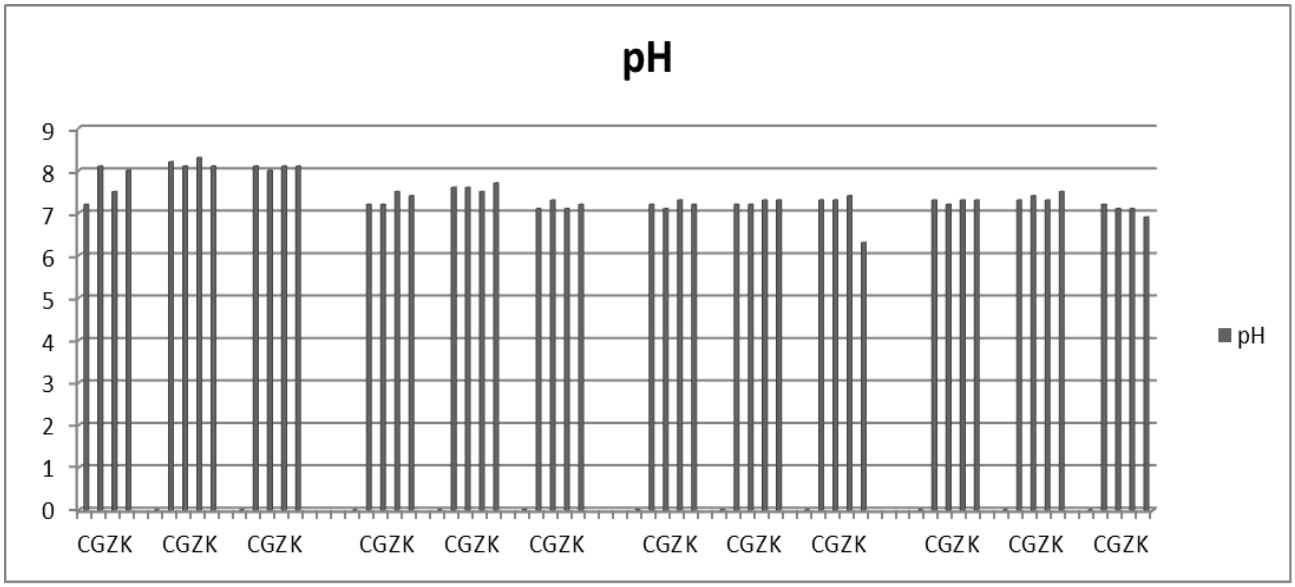


Fig 5.16


pH
9
8
7
6
5
4
3
2
1
0
CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK
pH

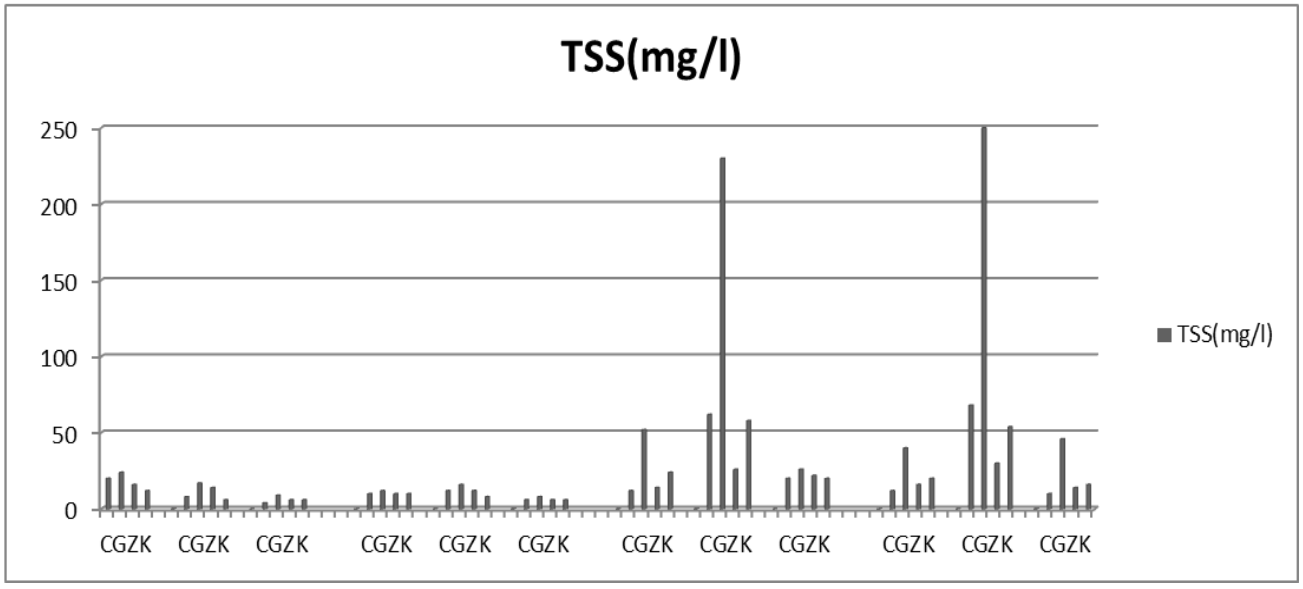
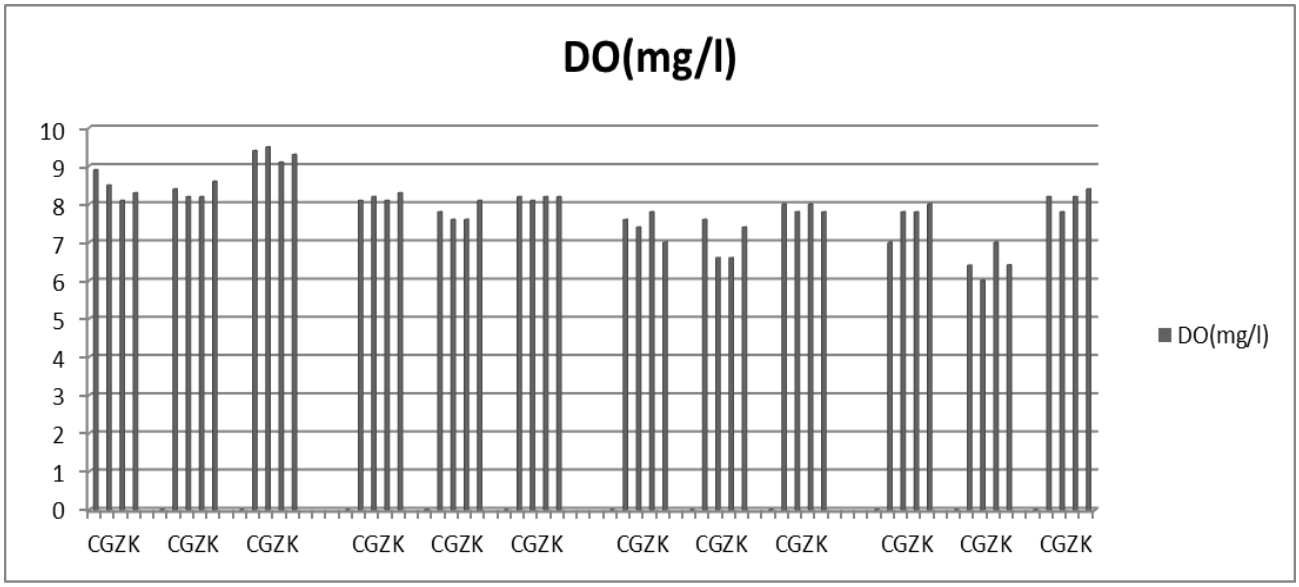

TSS(mg/l)
250
200
150
100
50
0
CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK
TSS(mg/l)

Fig 5.17


DO(mg/l)
10
9
8
7
6
5
4
3
2
1
0
CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK
DO(mg/l)

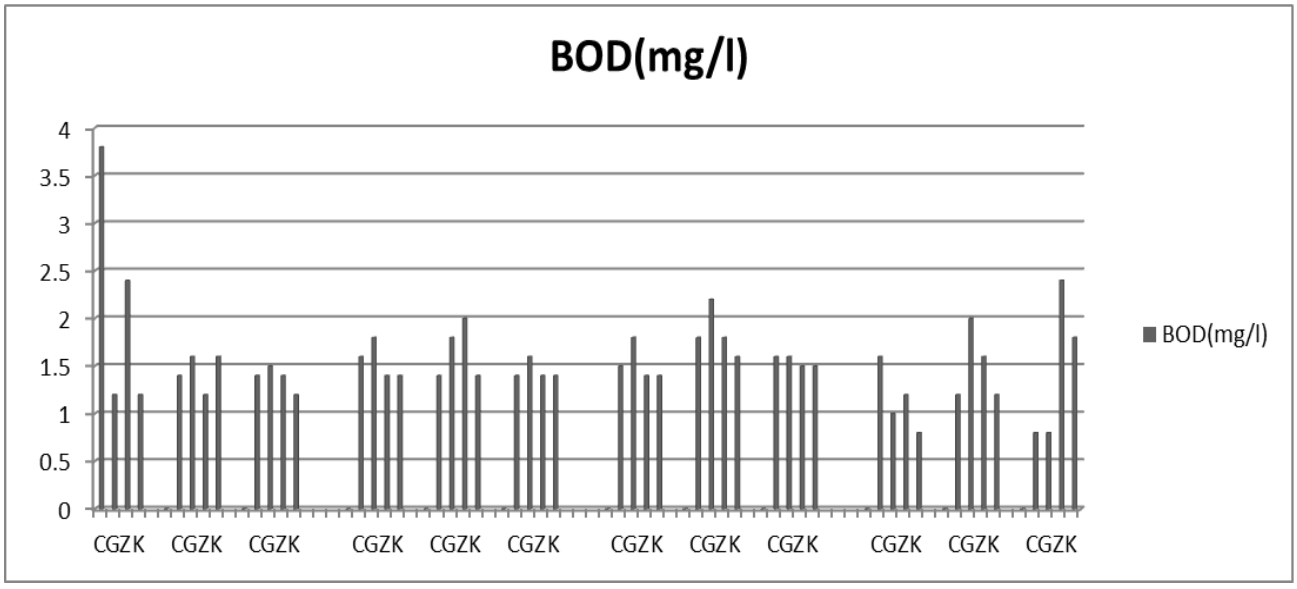

BOD(mg/l)
4
3.5
3
2.5
2
1.5
1
0.5
0
CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK CGZK
BOD(mg/l)

Fig 5.18

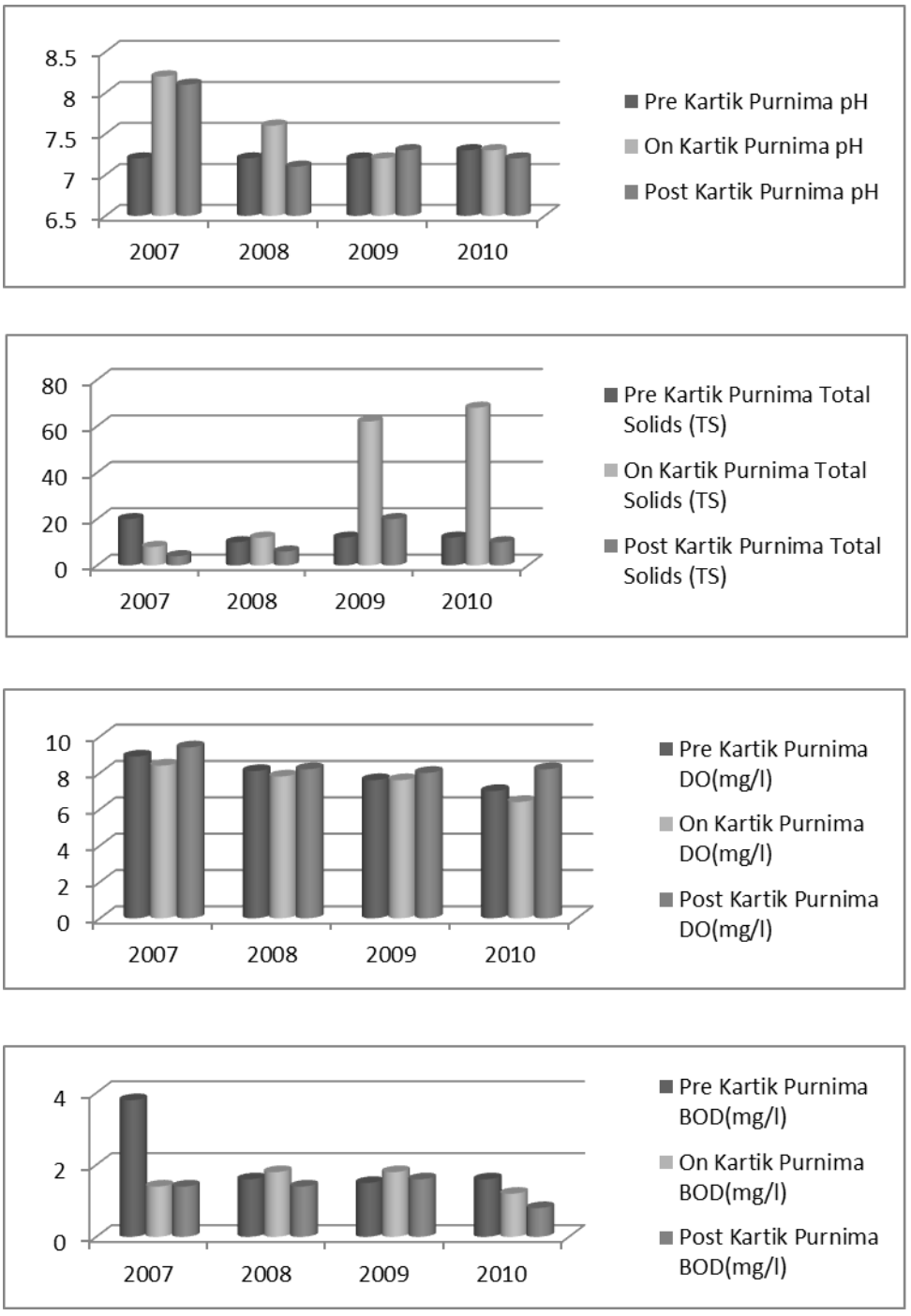
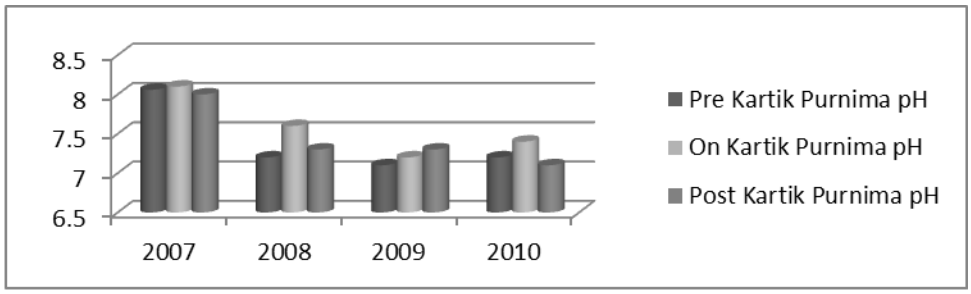
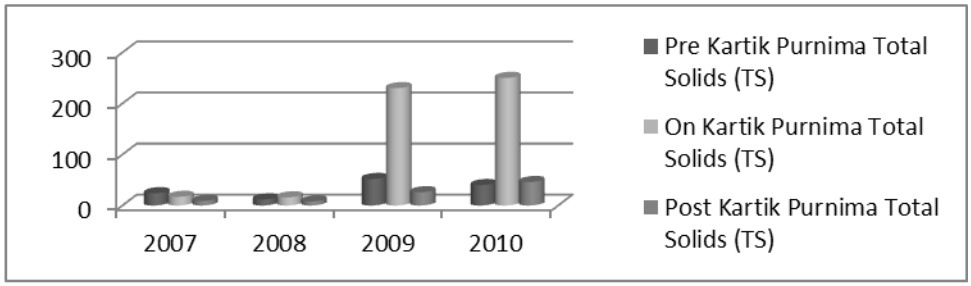
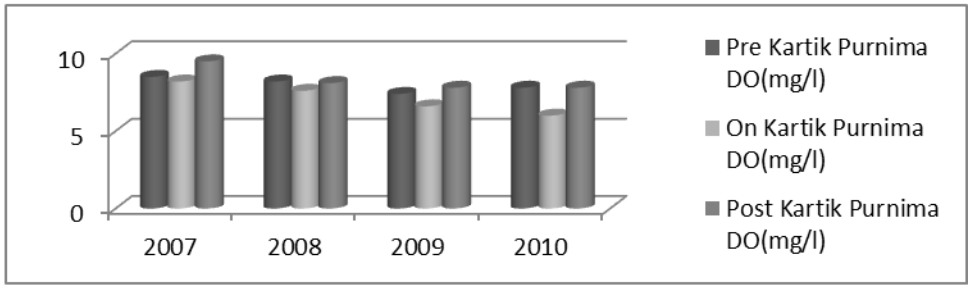

8.5
8
7.5
7
6.5
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH
80
60
40
20
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)
10
8
6
4
2
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)
4
2
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)
Post Kartik Purnima BOD(mg/l)

Fig 5.19


8.5
8
7.5
7
6.5
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH


300
200
100
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)

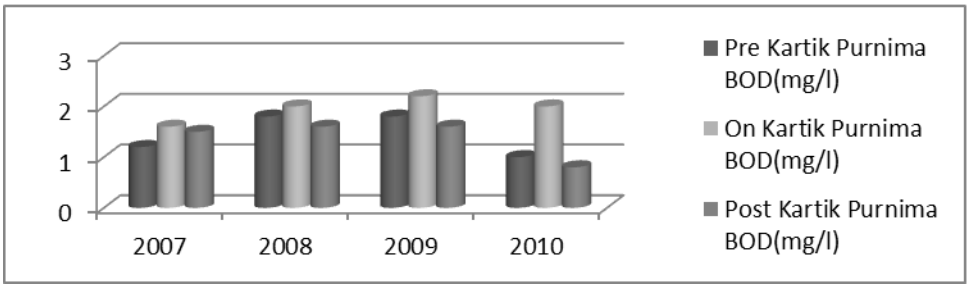
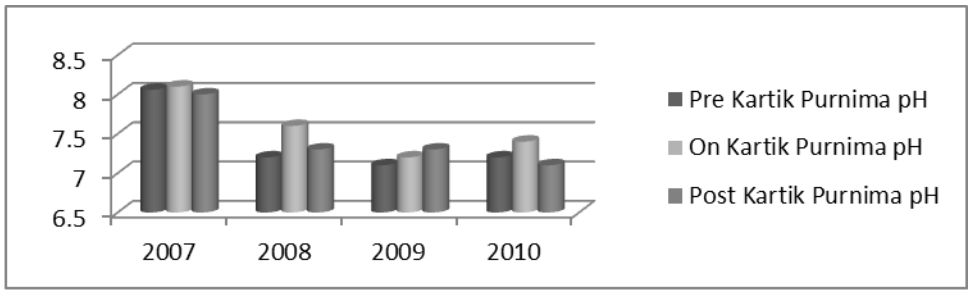
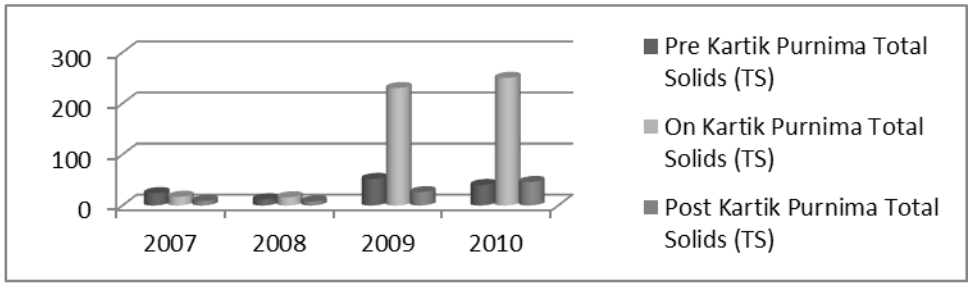
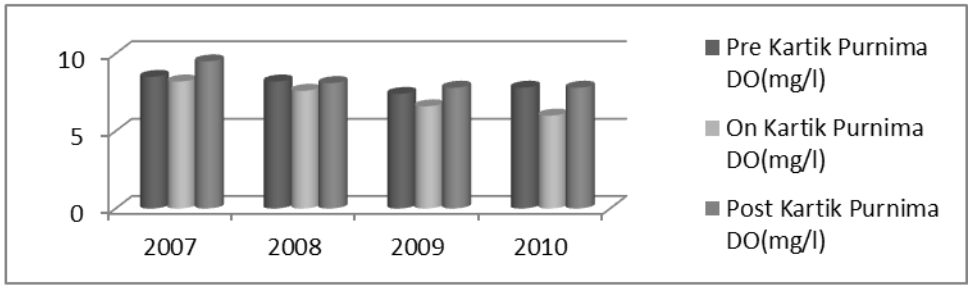

3
2
1
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)
Post Kartik Purnima BOD(mg/l)

Fig 5.20


8.5
8
7.5
7
6.5
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH


300
200
100
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)

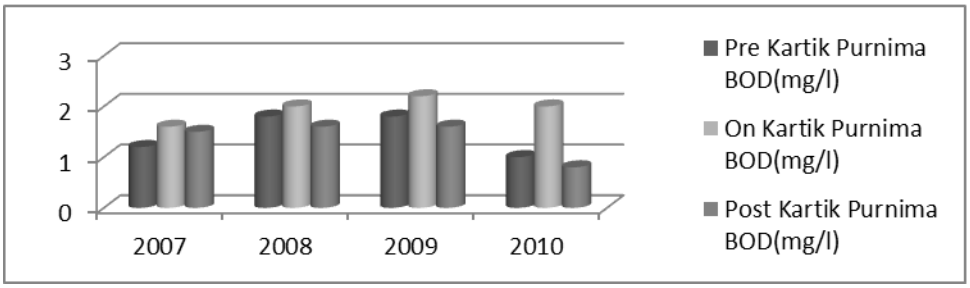
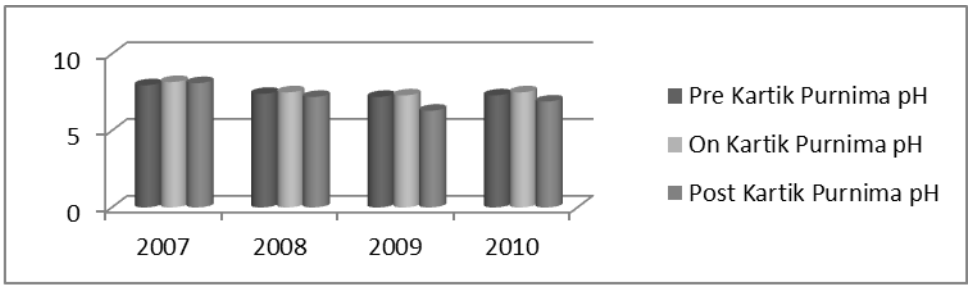
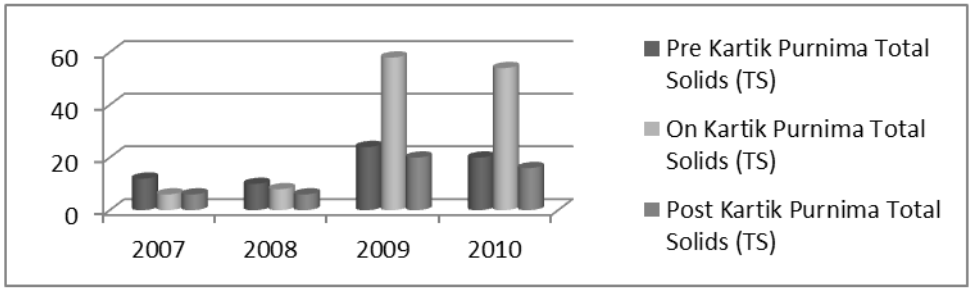
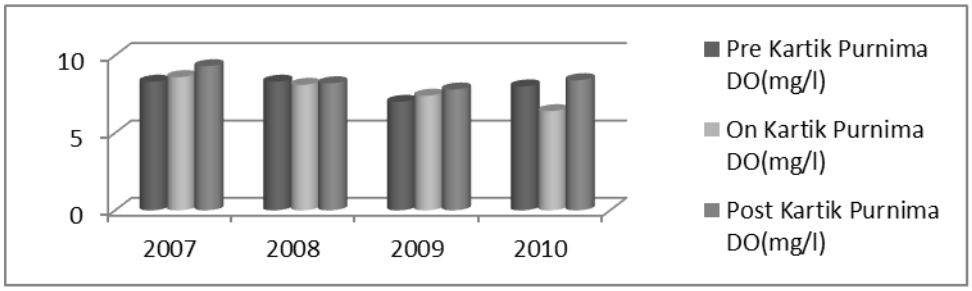

3
2
1
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)
Post Kartik Purnima BOD(mg/l)

Fig 5.21


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima pH
On Kartik Purnima pH
Post Kartik Purnima pH


60
40
20
0
2007
2008
2009
2010
Pre Kartik Purnima Total Solids (TS)
On Kartik Purnima Total Solids (TS)
Post Kartik Purnima Total Solids (TS)


10
5
0
2007
2008
2009
2010
Pre Kartik Purnima DO(mg/l)
On Kartik Purnima DO(mg/l)
Post Kartik Purnima DO(mg/l)

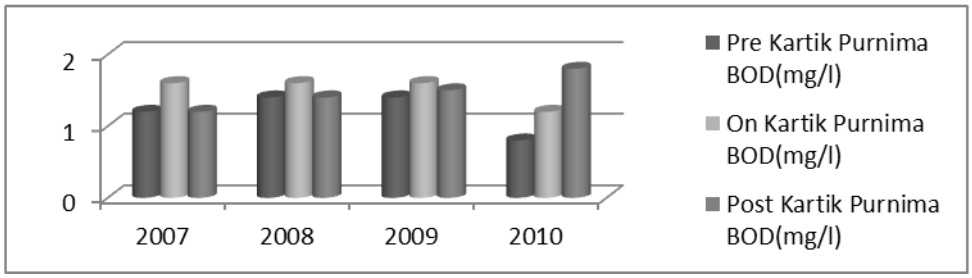

2
1
0
2007
2008
2009
2010
Pre Kartik Purnima BOD(mg/l)
On Kartik Purnima BOD(mg/l)
Post Kartik Purnima BOD(mg/l)

Fig 5.22

5.2.3 Sampling Analysis of Ground Water :

Due to various discrepancies, only 1 sampling and test could be carried out. The stations were Madhupatna, Buxibazar and Bidanasi lying within the city. The results were compared with the values obtained from Odisha State Pollution Control Board. It is presented in the following table.

Table 5.9

Parameter	**Madhupatna**	**Buxibazar**	**Bidanasi**	**Ground Water Board**
pH	7.3	7.9	6.9	7.2
Turbidity (NTU)	19	14	18	12
Total Solids(ppm)	1129	1412	1285	1048
Hardness (ppm)	128	157	192	148
Sodium (ppm)	304	408	322	298
Sulphate (ppm)	132	108	146	122
Chloride (ppm)	211	199	198	208

5.3 Discussions :

The parameters which were tested for the rivers Kathajodi and Mahanadi generally always lied in between the prescribed values only except some anomalies. The reason behind these exceptions can be attributed to various facts e.g. faulty methods of sampling, faulty analysis, considerable increase in the activity of the population on some particular days like Kartik Purnima, effluents on a particular time of a day or week etc.

For Kathajodi river, the Gopalpur sampling site showed the most exceptions as it is a village and people directly depend on the river for their daily activities because of which BOD at times was too high as compared to the other points. Turbidity also constantly gives a higher value for all the sampling points on the particular day of Kartik Purnima on account of the boat floating culture of the state on the same day and access to the river increases exponentially on that festival.

Similarly, for Mahanadi river, the Gadgadia ghat sampling site showed the maximum number of anomalies. The cause behind this can be attributed to the fact that there lie 2-3 villages surrounding this area and people are directly dependent on the river for their life. Turbidity also constantly gives a higher value for all the sampling points on the particular day of Kartik Purnima on account of the boat floating culture of the state on the same day and access to the river increases exponentially on that festival.

CHAPTER 6

CONCLUSION

Neglecting a few anomalies, generally all the parameters lied within the prescribed range though some of them are showing an increasing trend day by day viz. turbidity, BOD etc. which is obviously a threat for a dangerous tomorrow. Till they have not got the potential to cause any threat to the health. But if the present trend of effluent discharge from industry, garbage dumping, usage of barnyard manure etc. goes on, then it will surely cause a havoc within the next 10-15 years. The population of the city will be affected to a much greater extent as the rivers on the two sides are the main water-supplying units for such a thickly populated urbanization.

So, the preventive measures must be taken and implemented strictly from right now to get a control over the situation. It must be remembered that ”A STITCH IN TIME SAVES NINE”.

CHAPTER 7

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